

## **Historic, Archive Document**

Do not assume content reflects current scientific knowledge, policies, or practices.



JUL 13 1967

AGRICULTURAL

# Research

U.S. DEPARTMENT OF AGRICULTURE

JUNE 1967



## Combatting World Hunger

An undernourished child is a dull child. His thin arms cannot build the future; his tired eyes cannot see the universe; his impotent brain cannot spark the ideas that mean freedom, hope, progress.

And a nation of dull children cannot achieve greatness.

Protein deficiency—lack of meat, milk, eggs—is responsible for widespread malnutrition and deaths in many parts of the world. These same areas, however, grow seedcrops such as soybeans, cottonseed, and peanuts that are high in protein and energy. ARS is conducting a world-wide search to find other high-protein seed plants—plants that may now be grown for pasture or simply be considered weeds (p. 6).

But high-protein seeds are not enough. Low-cost and practical methods to process these seedcrops into edible foodstuffs must be developed.

ARS already has several achievements along this line. One of them is the five-step process for converting soybeans into full-fat flour. This simple process uses inexpensive and readily available equipment. Only the hulls are discarded. The end product is about 20 percent fat and 40 percent protein and could be used in beverages, soups and various cooked dishes.

Another ARS process removes the toxic pigment gossypol from cottonseed. By eliminating this objection to cottonseed meal as a feed, ARS may also have paved the way for a rich new source of protein—cottonseed flour.

ARS also formulated the high-protein CSM Mix now being distributed through voluntary agencies in about 80 developing countries. CSM stands for Corn, Soy, and Milk. The mixture can be prepared quickly as a beverage or porridge, and a 3½-ounce package supplies at least half the daily nutritional requirement recommended for a young child.

Foreign students from underdeveloped nations advise ARS scientists on food combinations and consumer preferences in their homelands and serve on taste panels to evaluate new recipes that incorporate high-protein foods.

ARS has long worked with the Agency for International Development (AID) and the United Nation's Children's Fund (UNICEF) to put new foods into use enriching protein-poor diets.

## AWARDS

- 8 Distinguished and Superior Service

## CROPS

- 3 Understanding Flower Colors
- 5 Harvesting Forage Seed

## INSECTS

- 11 New Grain Irradiator
- 12 Paint Lures Insects

## NUTRITION

- 7 Calcium and Kidney Stones

## SOIL AND WATER

- 10 Tests Aid Low-Income Farmers

## UTILIZATION

- 6 Evaluating Plant Seed Protein
- 13 Plus-Charged Flour
- 13 New Process for Stronger Flour

## WEEDS

- 14 Spray Emulsions Reduce Drift

## AGRISEARCH NOTES

- 15 New Bermudagrass Hybrid
- 15 Analyzing Cattle Blood Types
- 15 Low-Oxygen Potato Storage
- 16 Sweeping Up Soil Samples
- 16 Screening for Nematode Resistance

*Editor: R. P. Kaniuka*

*Contributors to this issue:*

*H. L. Brinson, E. H. Davis,  
Marshall Gall, M. B. Heppner,  
D. H. Mayberry, J. G. Nordquist,  
R. G. Pierce, D. M. Webb,  
A. D. Wynn*

AGRICULTURAL RESEARCH is published monthly by the Agricultural Research Service (ARS), United States Department of Agriculture, Washington, D.C. 20250. Printing has been approved by the Bureau of the Budget, August 15, 1958. Yearly subscription rate is \$1.50 in the United States and countries of the Postal Union, \$2.00 in other countries. Single copies are 15 cents each. Subscription orders should be sent to Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Information in this periodical is public property and may be reprinted without permission. Mention of the source will be appreciated but is not required.

Orville L. Freeman, Secretary  
U.S. Department of Agriculture

G. W. Irving, Jr., Administrator  
Agricultural Research Service

*Cornflowers, sometimes called bachelor's buttons, are grown in the greenhouse. When blooms are fully open, they are collected and taken to the laboratory for tests.*



ST-2124-2

## UNDERSTANDING

# Flower Colors

CORNFLOWER-BLUE ROSES may not be as impossible as they sound if ARS researchers can learn to manipulate certain chemical processes that occur in flowers.

Rose growers have sought a blue rose in vain for years. The "blue rose" that growers refer to today is actually silver-grey or lilac-colored. A rose with the deep blue coloring of the cornflower has yet to be developed.

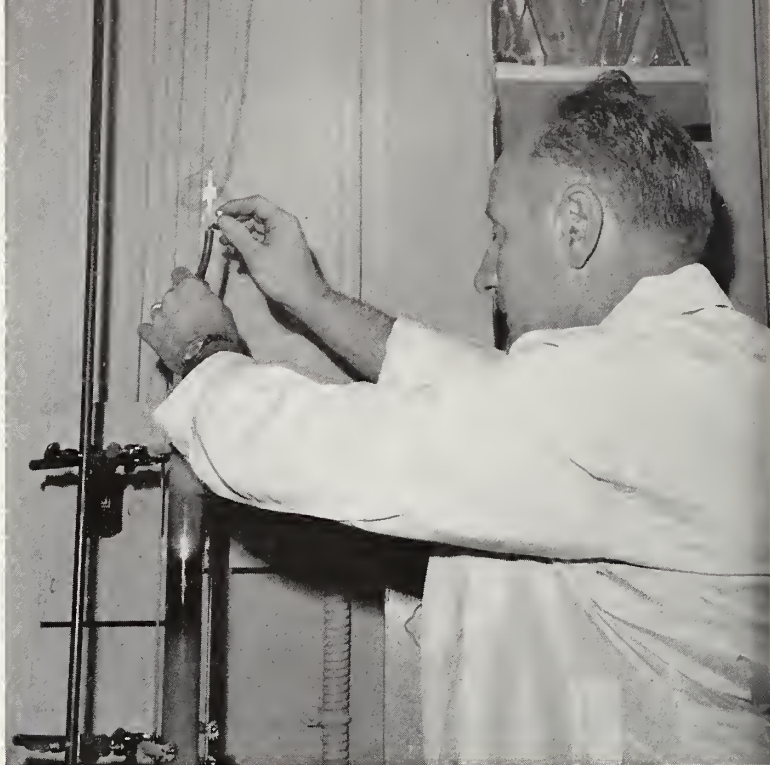
But ARS researchers are making progress. Research physiologist Sam Asen and associates at Beltsville, Md., have produced some blue pigments chemically in the laboratory and have clarified what is known about how natural blue pigments occur in flowers.

## UNDERSTANDING FLOWER COLORS (Continued)



ST-2124-6

*A laboratory technician pulls petals off the cornflowers, then dries, grinds, and dissolves them in a solvent. Physiologist Sam Asen, right, separates the pigments in the petal solution by column chromatography. The separated pigments are then purified and crystallized.*



ST-2124-

Flowers are colored primarily because they contain natural pigments that absorb light, but the occurrence of stable blue pigments is complex and only partially understood. Blue pigments are red originally, and red pigments are derived chiefly from chemical compounds known as anthocyanins.

Three known factors modify red anthocyanins to produce blue pigments: the alkalinity or acidity of the plant tissue, processes known as metal chelation, and co-pigmentation, or the formation of anthocyanin complexes with other substances in the plant. These factors do not function independently, however, and their interaction adds to the difficulty of understanding how they work.

In these studies, ARS researchers found that anthocyanins can exist in three different forms, each with a different color, depending in part on the acidity or alkalinity of the flower's plant tissue. Red anthocyanins gradually fade, changing to completely colorless as the plant tissue becomes less acid.

And, reversing the situation an anthocyanin present in its colorless form can be changed to its colored form simply by adding acid.

The red and colorless forms are the two extremes. In the middle is the bluish form, which the red anthocyanins pass through when changing to the colorless form.

At first glance, it appears that all that would be necessary to produce blue pigments—and thereby get a blue flower—is to weaken the acidity. But the bluish form of the anthocyanin is very unstable and changes almost immediately to the colorless form. This instability shows that changes in acidity alone do not produce stable blue pigments.

In some plants, certain metals will stabilize anthocyanins in the bluish form, a process called metal chelation. The classic example of this process is the effect aluminum has on the hydrangea. Hydrangeas produce bluish flowers when plants accumulate aluminum, and red flowers when aluminum is restricted.

Acidity also plays a part in metal

chelation, however, and stable blue anthocyanin chelates will not form if the flower's tissue is below a certain acidity level.

Of the three known factors that modify red anthocyanins to produce the blue pigments in flowers, co-pigmentation is the least understood. As early as the 1930's, scientists suggested that great color changes could be caused by the formation of anthocyanin complexes with other substances in the plant.

ARS studies indicate that these co-pigment complexes are formed only in the presence of a metal—such as in the blue cornflower, for example—but whether it is universal for all blue flowers is uncertain.

While these data are not yet complete enough to make the production of unusual blue flowers imminent, the investigations have at least brought the idea within reach.

ARS researchers believe that as they go further in their investigations of conflower-blue roses—already within the realm of possibility—may become a reality.■

# HARVESTING FORAGE SEED

**SEED MOISTURE**—not crop age—is the best index for determining when to harvest forage crop seed.

In several years of ARS tests on seven grass and legume crops where seed moisture was used as an index to harvesting, total losses were reduced by 16 percent.

The experiments, conducted by agricultural engineer L. M. Klein, show that seed moisture content can be measured easily and is closely related to crop maturity. Moisture content generally averages from 60 to 65 percent in immature forage crops. As the crop matures, moisture gradually drops. Because a crop may mature at varying times depending on climate, soil, and fertilizer applications, harvesting at the same time each year can result in substantial losses from shattering or from production of light, immature seed.

Klein took his moisture readings with an ARS-developed exhaust heat moisture tester (AGR. RES., Oct. 1964, p. 16). The unit costs about \$60 and involves no calibrations, calculations, or temperature corrections. Drying time takes from 6 to 10 minutes, and accuracy of the unit at moistures up to 65 percent is within 2 percent, plus or minus.

In using the moisture tester, the sample container is placed on the scales and the scale face rotated until the pointer rests on 100 percent. The container is filled with the seed until the pointer reaches zero. Then the container is placed on the base assembly, the unit is connected to the exhaust pipe and the sample is dried for 4 or 5 minutes at 300° F. When the container is replaced on the scales, the pointer will indicate the percentage of moisture directly. Repeating the dry-

ing and weighing procedure until two identical readings are obtained will give the correct seed moisture percentage.

Research results of seed-crops Klein tested, in cooperation with the Oregon Agricultural Experiment Station, Corvallis, are summarized below.

**Crimson Clover**—Highest viable seed yields were obtained by mowing at a seed moisture content of 35 percent. A survey of farmers showed they generally cut the crop seven days later at a seed moisture content of 16 percent. At 35-percent seed moisture, the crop yielded 22 percent more viable seed.

**Alta Fescue**—Highest viable seed yields were obtained by mowing at 43-percent moisture content. This took place 6 days earlier than the normal cutting time at 25-percent seed moisture. Mowing at 43-percent seed moisture yielded a 14-percent increase in viable seed.

**Fineleaf Fescue**—Highest viable seed yields were obtained by mowing chewings fescue at 27-percent and creeping red fescue at 24-percent seed moisture. These figures compared to 42 and 45 percent for the farmers and indicated a mowing time 5 days later.

Mowing at optimum time brought a viable seed increase for both varieties of 14 percent.

**Subterranean Clover**—Highest viable seed yields were obtained by mowing at 22-percent moisture content 5 days before the conventional harvest date. Mowing at 22 percent gave a 32-percent increase in yield of viable seed.

**Bluegrass**—Highest viable seed yields were obtained by mowing at 23-percent moisture content. Farmers generally harvested 7 days later at 13-percent moisture content. At 23-percent moisture, viable seed yields increased 8 percent.

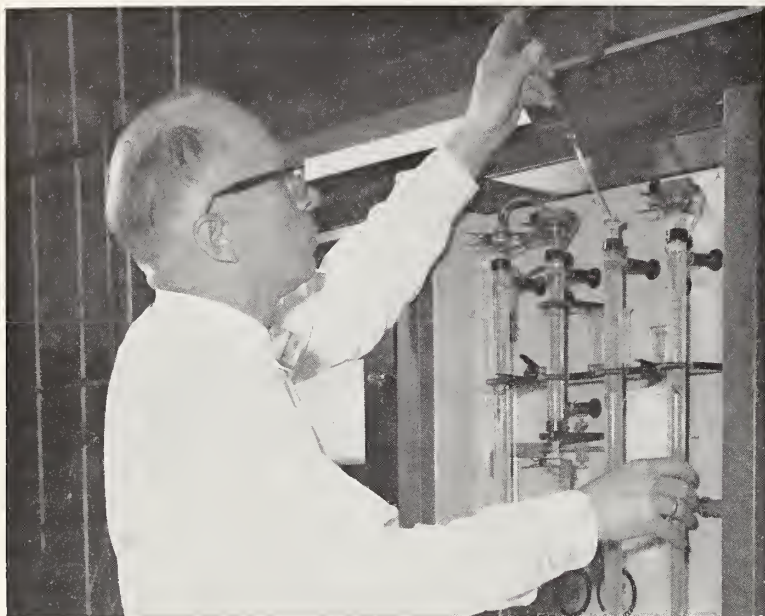
**Orchardgrass**—Highest viable seed yields were obtained by mowing at 44-percent moisture content. This differed little from the average 39-percent moisture in the farmers' survey, but represented a 4-day earlier cutting date. Resultant viable seed increases were 15 percent.

**Perennial Ryegrass**—Highest viable seed yields were obtained by mowing at 40-percent moisture content. This increased viable seed yield 8 percent. Growers usually cut 3 days later at 33-percent seed moisture. ■

*L. M. Klein, using a moisture tester connected to the truck exhaust pipe, dries a sample of orchardgrass seed.*

PN-1497





PN-1498

*To Fight World Hunger, Scientists*

## **EVALUATE PLANT SEED PROTEIN**

**F**AMILIES IN MEAT-SCARCE regions of the world may someday eat nutritional alternatives to T-bone steaks—food containing seed protein from plants that now grow wild in Africa, India, and elsewhere.

Seeds that might be sources of protein for human diets are the object of the largest search ever made to meet the world protein shortage. Since 1957, ARS scientists have surveyed 4,000 plant species for seed protein content. And they have analyzed 379 species for amino acids—more than 4 times the number of species for which reliable amino acid values were available when the survey started.

Amino acids are the building blocks of protein. For optimum growth each animal species, except ruminants such as cattle, requires certain essential amino acids that the animal can not synthesize.

Theoretically, scientists could combine just the right seed proteins to

PN-1499

*Above: Chemist C. H. Van Etten analyzes seed proteins for amino acids. Below: Technician C. R. Martini (left) operates a seed cleaner while M. A. Spencer, science aide, separates hulled seeds from dehulled seeds.*



give man a pattern of amino acids as good as that in eggs, steak, or milk.

Evaluating seed proteins for amino acids is part of new crops research under I. A. Wolff at the Northern utilization research laboratory, Peoria, Ill., and Quenton Jones, Beltsville, Md. (AGR. RES. January 1963). The proteins are compared to that in egg, which is considered ideal for man.

The seed proteins were analyzed at the Northern laboratory by C. H. Van Eeten, J. E. Peters, R. W. Miller, and C. E. McGrew. W. F. Kwolek, and A. S. Barclay conducted statistical and botanical studies.

Proteins from some of the 379 species "have a better pattern of essential amino acid composition than many currently used seed sources," Van Eeten reports. "Most of the plants would serve as good sources of seed protein if they could be grown, harvested and processed efficiently."

Some of the plants are grown as crops but not used as seed protein sources. Crimson clover, for example, is grown for hay. Most of them, however, are wild or grown on such small scale that they are not well known. Many of the seeds contain toxic substances that must be inactivated or removed by processing before the protein can be eaten.

The amino acid evaluation shows that the amounts of such amino acids as leucine, phenylalanine, threonine and valine in the 379 seed proteins are generally adequate for man.

More than half of them contain enough lysine. Lysine deficiency is a current problem in some areas, because cereals, a major source of food, contain too little of this essential amino acid.

Proteins from crambe, a new oilseed crop, and lesquerella, a potential crop, are rich in lysine and contain larger amounts of the methionine-cystine combination than most seed proteins.■

# CALCIUM AND KIDNEY STONES

**C**ALCIUM, A KEY MINERAL for proper nutrition, also forms part of some kidney stones, a painful disorder of man and animals.

To find out what turns "good" calcium that helps form bones and teeth into "bad" calcium that forms kidney stones, ARS scientists studied the components of milk, a major source of calcium for many people.

ARS biochemist Madelyn Womack at Beltsville, Md., fed five diets containing natural and refined milk components or related ingredients from plant sources to rats from weaning to maturity.

The five diets consisted of skim milk and butter oil; milk sugar and butter oil; milk sugar and corn oil; cornstarch and butter oil; or corn oil and cornstarch.

After 1 year on the experimental diets, the rats were examined for kidney stones. About 47 percent of the rats fed skim milk plus butter oil had kidney stones, and about 29 percent of the rats fed milk sugar and butter oil had stones.

But less than 5 percent of those on milk sugar and corn oil had kidney stones, and none of the rats on corn starch had them. Substituting corn starch for milk sugar or substituting corn oil for butter oil drastically reduced kidney stones.

Womack then compared the

amount of minerals reaching the kidneys of rats on each diet.

If less calcium for kidney stone formation gets to the kidneys, fewer stones might form. She determined the amount of calcium in each diet, subtracted calcium excreted in the feces or deposited in body tissues, and took the remainder as an indication of the load on the kidneys.

Using the skim milk diet as a base, the relative calcium load of each diet on the kidneys was:

Skim milk diet.....	1.00
Milk sugar and butter oil diet....	.81
Milk sugar and corn oil diet.....	.31
Cornstarch and butter oil diet....	.23
Cornstarch and corn oil diet.....	.43

Evidence from many earlier experiments suggests that milk sugar enhances the body's uptake of calcium. In itself, this is favorable, because the body's calcium supply may be too low without this boost. But in two of the diets containing milk sugar, the boost appears to have gone too far.

Some minute differences in the relative proportions of minerals in the milk sugar-butter oil and milk sugar-corn oil diets may be implicated. It is possible, for example, that minerals in other foods at meals where milk is drunk may determine whether too much calcium reaches the kidneys.■

# For Distinguished and Superior

FOR OUTSTANDING achievement, sixteen individuals and one group from ARS recently received Distinguished and Superior Service Awards.

Secretary of Agriculture Orville L. Freeman announced the citations and presented the awards at USDA's 21st annual awards ceremony held May 16 in Washington, D.C.

## For Distinguished Service

Herman A. Rodenhiser, *Deputy Administrator, Farm Research*, for distinguished leadership in inter-agency research and for conceiving and planning original research on new and complex agricultural problems. Dr. Rodenhiser was instrumental in organizing and guiding wide-ranging research on rust diseases of cereal crops. He also developed research in the new field of remote sensing—using sensors in planes and satellites

to determine conditions of terrain, soils, and vegetation.

Raymond C. Bushland, *Entomology*, for developing and applying unique methods of controlling livestock pests and protecting humans from disease-carrying insects.

Cecil H. Wadleigh, *Soil and Water*, for exceptional foresight and ability in planning, developing, and leading a national program of soil and water conservation research.

## For Superior Service

Fire-Retardant Coatings Group, *Southern Utilization*, for developing effective, water-resistant, fire-retardant paints suitable for civilian, industrial, and military needs. These paints suppress the spread of flames, giving fire fighters a better chance to arrive at fires before flames engulf the building.

Mildred Adams, *Human Nutrition*,

for leadership and pioneering advances in human nutrition research. Her basic discoveries of the role of carbohydrates—sugars and starches—in our diets are major contributions to better human nutrition.

Lawrence P. Batjer, *Crops*, for contributions to fruit tree research. His research and leadership have increased production of deciduous fruit

trees, improved orchard management, and saved growers many millions of dollars, both here and abroad. He demonstrated that chemical sprays can control tree size and fruit development.

Theodore E. Bond, *Agricultural Engineering*, for leadership in designing livestock facilities that provide the best possible environment for efficient livestock production. His findings have been accepted as standards throughout the world.

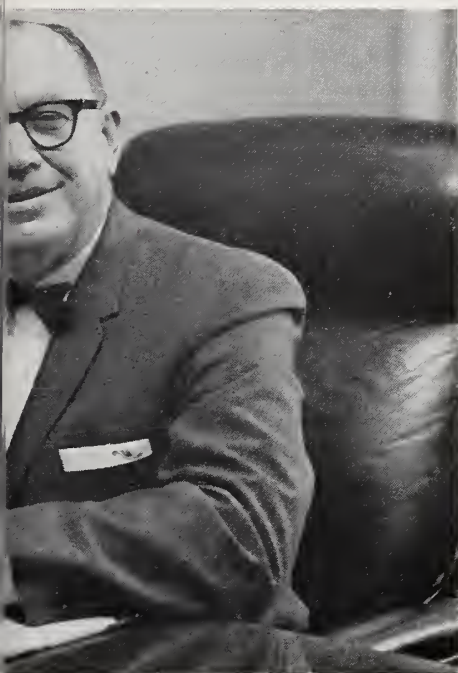
Ron G. Buttery and Roy Teranishi, *Western Utilization*, for research that has revolutionized the chemistry of food flavors. From gas chromatographic techniques and equipment they developed sensitive tools for isolating the compounds that produce aromas in foods.



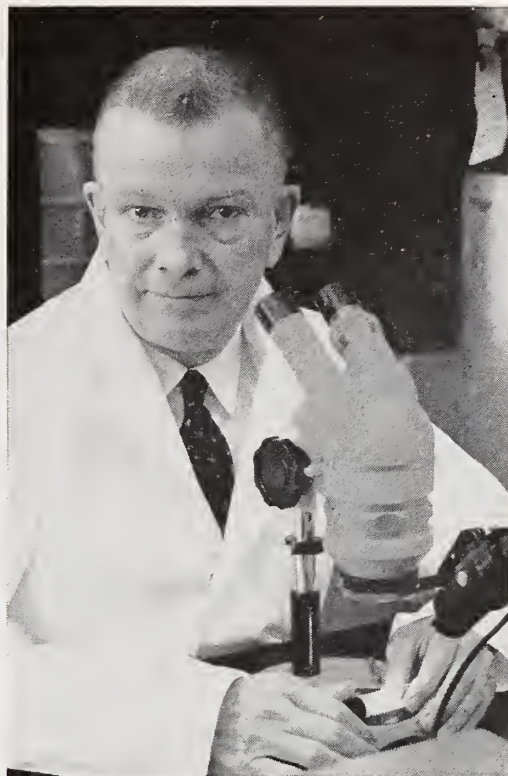
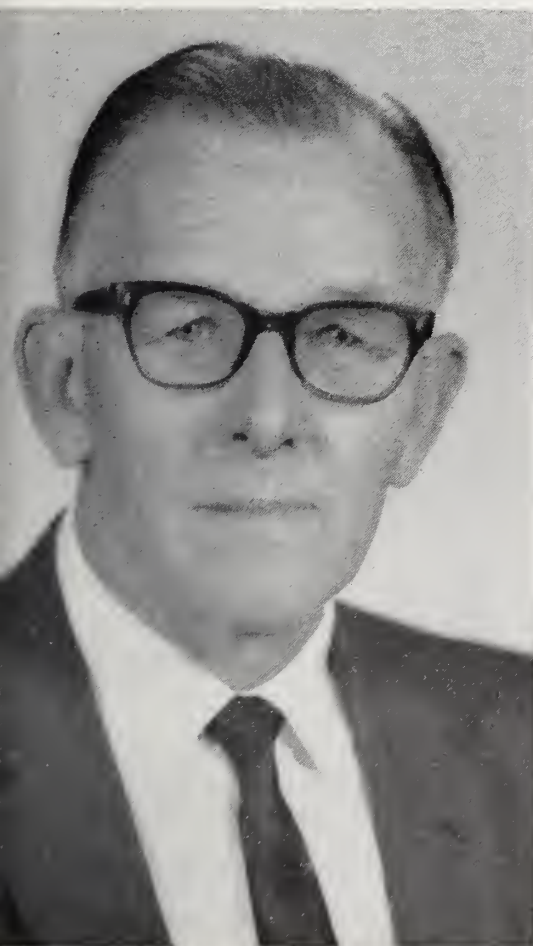
PN-1500

Above: Cecil H. Wadleigh.  
Right: Herman A. Rodenhiser.

# ervice



BN-16990



PN-1502

Raymond C. Bushland.

Steve A. Eberhart, *Crops*, for developing methods of maize (corn) breeding suitable for developing countries and for demonstrating that such methods can lead to substantial production increases.

William P. Flatt, *Animal Husbandry*, for research leadership on the energy metabolism of dairy cattle. Dr. Flatt developed an efficient and automated energy metabolism laboratory that has greatly accelerated progress in this type of research. His studies provide the basis for devising new, scientifically sound, and economically feasible feed evaluations for cattle.

A. Kenneth Hatch, *Operations Analysis and Systems Development*, for outstanding leadership in the ARS Cost Reduction and Operations Improvement Program. Under his direction, the number of ARS improvement efforts more than doubled in the past year, and during fiscal year 1966, cost reduction actions saved more than \$7.4 million.

James L. Hourrigan, *Animal Health*, for outstanding service to the Nation's sheep industry by developing

and guiding the National Scrapie Eradication Program. This program has restricted the disease to 3 breeds of sheep and to an average of only 15 cases annually. In countries without such a program, the disease is reported in some 27 breeds and cross-breeds with an estimated 10,000 to 20,000 cases annually.

Talmadge W. Little, *Operations Analysis and Systems Development*, for his achievements in professional personnel recruiting, equal employment opportunity and other programs for the disadvantaged, and for providing unusually effective technical contributions and leadership to ARS personnel programs.

Hickman C. Murphy, *Crops*, for conceiving, leading and conducting research that has protected oats from disease losses and provided an abundance of better quality oats for food and feed. His research has had worldwide impact on oat variety improvement.

James W. Pence, *Western Utilization*, for research and leadership in cereal chemistry that included improving baked products and developing new wheat foods for domestic and export markets, and for research aimed at developing new cereal foods for world feeding programs.

Roy J. Smith, *Crops*, for studies on weed control measures that increase rice yields, and for establishing the interrelationships of pesticides, fertilizers, and water management practices in rice production. The improved weed control measures developed by Dr. Smith allow increased rice production per acre at less cost. ■

*Ref Card only*

*Engineering technician V. A. Carlson operates the portable wind tunnel in the field to determine the erodibility of the soil.*

**A**N ARS RESEARCHER is blowing up a storm to help improve the incomes of farmers in central Minnesota.

L. F. Hermsmeier, agricultural engineer at the North Central Soil Conservation Research Center in Morris, Minn., took an experimental wind tunnel to Brooten, Minn., this spring to test the sandy soils of the area for wind erosion susceptibility.

Hermsmeier's work is part of a collaborative effort by government, industry, and local leaders to stabilize the economy of the Brooten area. A major food company last year began contracting Brooten farmers to grow string beans for canning.

The sand flats of the area provide only marginal incomes for grain and dairy farmers, but are made to order for growing fancy vegetables. Canning companies prefer to grow vegetables on soils of low nutrient content because they can apply fertilizer to exact specifications. They also like well-drained soil because their crops are usually irrigated.

Sand meets these requirements, but it also cuts and bruises young vegetables if blown by wind. Hermsmeier's experiments will help determine how much wind erosion can be expected in the area and what measures are needed to prevent it.

"We have tillage and other cultural practices that will protect soil from wind erosion," Hermsmeier said, "but we must know something about soil erodibility, degree of cloddiness, surface roughness, and cover conditions in a given area before we can choose the best practice."



*To Help Low-Income Farmers . . .*

## WIND EROSION TESTS

Hermsmeier used a 50-foot-long wind tunnel that can approximate the blowing effects of winds up to 35 miles per hour. It was designed and built by ARS erosion specialists at Manhattan, Kans., and has been used to determine erodibility of soils throughout the Midwest.

The scientist placed the tunnel at representative points in the Brooten area and tested erodibility and other characteristics of the soils. By comparing his data with data compiled at Manhattan over a 30-year period, he will be able to recommend specific erosion control practices for most of the study area.

About 320 square miles of marginal land is involved in the Brooten project. Farm income has been declining there for several years and farmers have been leaving to find work elsewhere.

Two years ago, canning company representatives established experi-

mental plots of snap beans in the area. The experimental plots grew well, and last year the company signed contracts with 12 area farmers to grow small acreages of beans. The company furnished seed, fertilizers, and technical assistance.

Again, the results were encouraging. The farmers harvested an average of 7,000 to 8,000 pounds of beans per acre. At the contract price of 2 cents per pound, they grossed \$150 to \$160 per acre—a substantial improvement over financial returns from the 40-bushel-per-acre corn yields common in the area.

ARS scientists are now working on plans for an irrigation research project to be financed in part by local farmers and businessmen. At present, few farmers in the area can afford irrigation.

The irrigation researchers will seek ways to make irrigation systems practical on a large scale. ■

# New Grain Irradiator

**T**HE WORLD'S FIRST free-flowing bulk grain irradiator at Savannah, Ga., may turn radiation to the control of insects and molds in stored grains and processed foods.

The irradiator, made available by the Atomic Energy Commission, will enable ARS scientists to carry out irradiation tests on a larger scale than ever before—a scale approaching commercial conditions. In addition, the irradiator is simple in design and uses standard grain-handling equipment. If successful, the same design could be enlarged for a unit with commercial capacity.

HAMILTON LAUDANI, director of the Stored-Products Insect Research and Development Laboratory, Savannah, Ga., will direct the research, utilizing information from earlier laboratory studies where insects were usually exposed in the absence of commodities. Grain and food industries will cooperate in much of the study.

The researchers will determine the dosages required to kill or stop development of insects in various commodities, the effects of radiation on food quality, and whether radiation is as practical as other control methods.

In the irradiator, grain flows by gravity from bulk storage through the

radiation chamber where it is exposed to the Cobalt-60 source contained in 13 parallel rods. By controlling the flow rate of the grain, the scientists can vary the amount of radiation the grain receives. A flow rate of 5,000 pounds per hour, for example, will allow an estimated dose of 25,000 rads. Rads are units for measuring absorbed radiation.

The irradiator will handle from 2,500 to 10,000 pounds of grain per hour at other dosage rates. The grain is moved from the bottom of the chamber by air pressure.

To ensure uniform radiation dosages at all positions across the chamber, the outer ends of each source rod and the entire length of the two outer rods are more strongly radioactive than the source rods in the center of the row. When not in use, the Cobalt-60 rods are housed in a lead cask mounted in the concrete cell wall.

RADIATION STUDIES with bulk commodities will include various grains, peanuts, legumes, coffee, cocoa, and different formulations of animal feeds.

Packaged foods can also be irradiated with the same Cobalt-60 source. The source rods can be moved through the grain chamber into the package-irradiation area. Packages are fed

into the irradiation chamber on a conveyor, which stops in eight different positions above and below the source rods. Radiation dose is controlled by the time allowed at each stop. About 2,000 pounds of packaged food can be irradiated per hour.

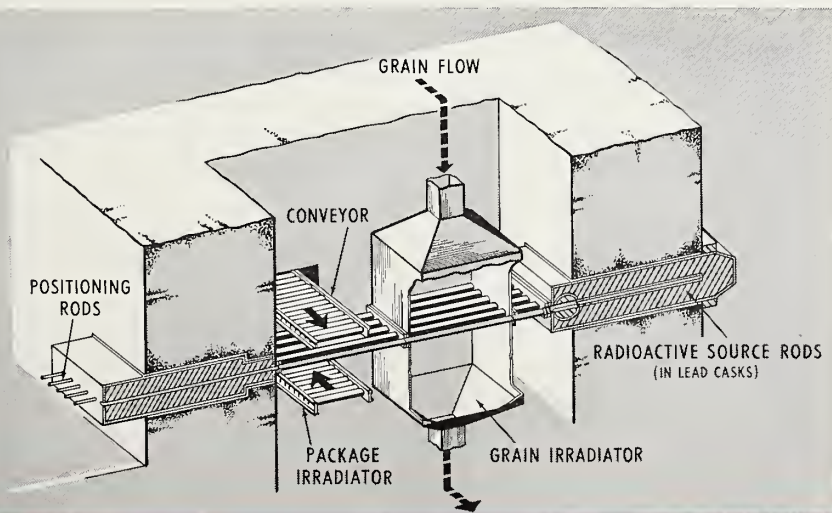
Packaged commodities to be tested include wheat flours, cornmeal and other corn products, milled rice, breakfast cereals, cake mixes, dried fruits, nut meats, dry legumes, spices, and dry animal feeds.

LETHAL RADIATION doses vary greatly depending on the kind of insect and the stage of development. A dose that will kill an insect in the immature stage may be much smaller than the dose needed to kill the adult insect.

Radiation may also have a long-term effect on insect development. For example, a larva may not develop from an irradiated egg, nor an adult from an irradiated pupa or larva.

Radiation may affect insect reproduction by interfering with the development of reproductive organs or by inhibiting mating.

The possibility that insects may develop resistant strains will also be studied. Successive generations of insects will be exposed to low doses and their development watched closely. ■

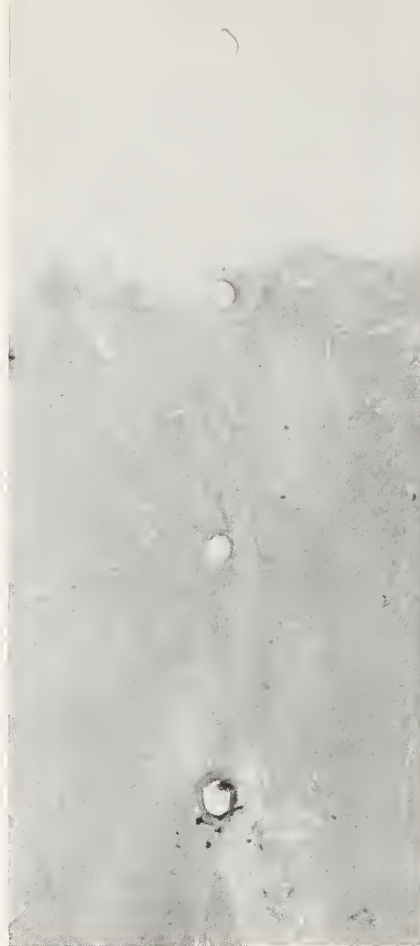


*Cutaway diagram shows how the radioactive source, 13 parallel rods, can be positioned in the grain or package irradiation areas by pulling the rods from right to left. Grain flows through the top of the irradiation chamber, past the radioactive source rods, then out to storage. Packaged foods are conveyed over and under the source rods.*

PN-1504

The two boards at right were coated with sticky substances to trap insects. The board at far right, covered with an acrylic auto paint, shows a heavy catch of sap beetles. The other board, a control, caught only a few insects. (University of Michigan photo)

## PAINT LURES INSECTS



PN-1505

**A**UTO PAINT IS the newest development in insect research. Two of the acrylic paints attract large numbers of a destructive sap beetle and may prove useful in insect traps.

A large outbreak of sap beetles in 1966 led to accidental discovery of the paint's potential use. The beetles ruined a \$3 million strawberry crop in Michigan.

At the same time, however, they were so strongly attracted to automobiles on which rust spots had recently been painted over with acrylic that painting had to be stopped.

In cooperative tests by ARS and Michigan State University, more than 1,000 sap beetles, *Stelidota geminata* (Say), responded to the paint within the first 24-hour test period.

At the end of the tests, 4 days later, averages of 1,600 and 2,333 beetles

had been drawn to traps containing the two most promising paints, red acrylics used as primers by a large American automobile manufacturer. Some traps attracted more than 3,000 beetles.

The sap beetles were drawn to small vials with paint-saturated wicks. The vials were attached to traps consisting of 4- by 9-inch cards covered with a sticky flypaper coating. Collections were highest in a strawberry patch adjacent to a pear orchard and lowest in another patch adjacent to a grape vineyard.

Beetles are attracted by the odor, rather than the color of the paint, ARS entomologist O. K. Jantz found. Sap beetles are usually drawn to decaying vegetation, especially fermenting fruit which, to the human sense of smell at least, has an odor considerably dif-

ferent from paint.

Timing is another important factor in attracting the insects to traps. They are most active at dusk and in mid-July in the area where the tests were made. At that time of year, not much fallen fruit is on the ground to compete with the paint in attracting the beetles.

Scientists will next determine whether the paint would be practical in sap beetle control. The entomologists also want to determine if the paint attracts injurious relatives of *S. geminata*, such as the corn sap beetle, antique sap beetle, dried-fruit beetle, and dusky sap beetle.

Early tests show that two unidentified kinds of flies are attracted by the paint, indicating that the paint may also be useful in trapping other insects. ■

## PLUS-CHARGED FLOUR

**F**LOUR WITH A positive charge is the latest in a series of chemically modified flours developed for use as paper additives.

This positively charged (cationic) flour adheres well to negatively charged wood pulp fibers from which paper is made. It is designed as an internal sizing agent to add strength to paper and in tests, performed as well as commercial additives.

In addition, the new flour product performed better than commercial products when tested as a retention aid to hold other chemicals in the paper.

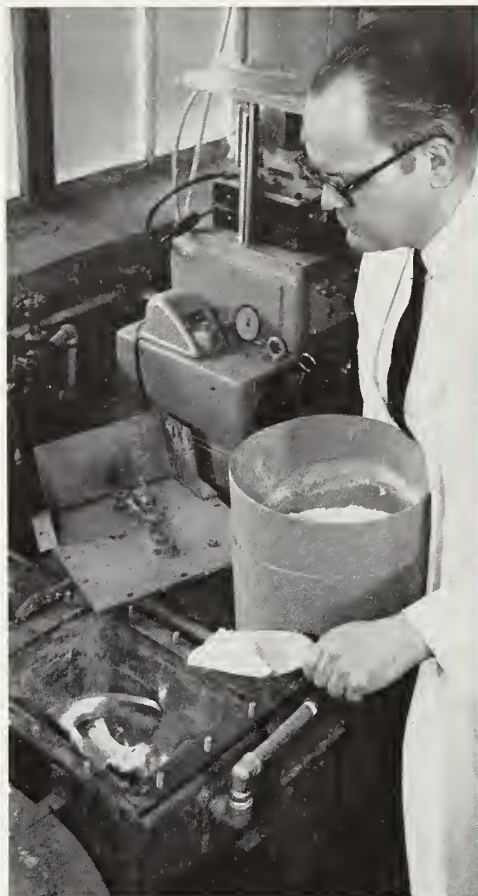
The research project, part of USDA's continuing effort to find new uses for farm crops, was conducted at the Northern utilization research laboratory, Peoria, Ill., by chemists J. C. Rankin, M. M. Holzapfel, C. R. Rus-

sell, and C. E. Rist.

Cereal flours cost less than most raw materials used as paper additives because they are less highly processed and refined. Their low cost and the increasing demand for cationic additives indicate a potential market for cationic flours.

The chemists made cationic flour on a laboratory scale by reacting dry flour of corn, wheat, or sorghum with a chemical called ethylene imide.

In earlier studies (AGR. RES., January 1961), Northern laboratory scientists reacted wheat flour with hydrochloric acid, ethylene oxide, propylene oxide, and sulfur trioxide to obtain four different kinds of modified flours. Acid-modified wheat flour is now undergoing trials as a surface-sizing agent to improve the surface properties of paper. ■



*Chemist J. C. Rankin puts flour into a mixer for the reaction with ethylene imide that produces cationic flour.*

## NEW PROCESS FOR STRONGER PAPER

**A**N EFFICIENT CONTINUOUS mixing process will now encourage manufacturers to make use of a cereal product that produces extra-strong paper.

The cereal product, called starch xanthide, mixed with wood pulp makes linerboard with 15 times as much wet strength as linerboard without xanthide. Linerboard is used to make boxes—corrugated paper is sandwiched between two layers of linerboard. Xanthide also provides other desirable strength qualities to linerboard.

After working out the chemical pro-

cedures for deriving xanthide from cereals and determining the benefits of mixing it with pulp, chemists G. E. Hamerstrand, M. E. Carr, B. T. Hofreiter, and C. E. Rist of the Northern Utilization Research Laboratory, Peoria, Ill., developed this continuous mixing process for industrial use.

The heart of the new process is a mixer-reactor chamber in which starch xanthate and sodium hypochlorite, metered under about 10 pounds pressure, are forced against a fixed plate in a restricted area. The mixture then passes through a coil and forms starch xanthide.

This xanthide is fed into a pipe carrying a slurry of pulp, chemicals and water. Mixing is completed when the pulp slurry, now containing xanthide, passes through a simple pump to the paper machine.

Northern laboratory chemists earlier developed processes for making xanthide from corn starch, wheat flour, and other cereal grain fractions and for converting this cereal xanthate to xanthide.

Estimates of costs to make xanthate and a design for a xanthate plant were also developed in USDA contract research. ■

*For Aquatic Weed Control . . .*

## **SPRAY EMULSIONS REDUCE DRIFT**

**T**WO AQUATIC WEEDS that clog Southern waterways can now be safely sprayed from aircraft without danger of herbicides drifting off target.

Adding oil to thicken conventional herbicides eliminates the small droplets in the spray that cause the drift problem.

For economical reasons, aerial spraying is often used to control alligatorweed and water hyacinth, weeds that interfere with agriculture, fisheries, recreation, and boat traffic. Drift is sometimes a problem, however, because many other plants, including crops, are susceptible to herbicides commonly used in aquatic weed control.

In the tests, ARS researchers L. W. Weldon, R. D. Blackburn, H. T. De Rigo, and R. T. Mellen, Jr., applied the thickened sprays, called invert emulsions, and the conventional herbicide formulations (herbicide plus water) by helicopter. They tested both Silvex and 2,4-D, and the herbicide rate per acre was the same for all applications.

Specially treated cards placed perpendicular to the canal at intervals showed that the thickened herbicides did not drift or land more than 5 to 6 feet from the intended spot in the spray swath.

The tests were conducted in cooperation with the Florida Agricultural Experiment Station, the Central and Southern Florida Flood Control District, and the U.S. Army Corps of Engineers.

Because the invert emulsions are thicker than conventional formula-

tions, special applicators are required. The scientists tried both a spinning disk that distributes the herbicide by centrifugal force and a bifluid spray system.

In the disk system, the invert emulsions are premixed and carried in a single tank on the helicopter. In the bifluid system, one tank contains the oil and another, the herbicide formulation. The oil and herbicide are pumped separately to special noz-

zles where the invert emulsion is formed as the herbicide is sprayed from the helicopter.

The bifluid system distributed the invert emulsion sprays more evenly than did the spinning disk.

Placing the spray effectively with the spinning disk required more care and, in some parts of the trials, the spray did not reach all the weeds. The herbicide must actually land on the leaves to be effective.■

*With the bifluid system, special nozzles are mounted on the boom below the helicopter to apply the invert emulsions. The spinning disk, or centrifugal spreader (lower photo) can be used to apply premixed invert emulsions.*

PN-1507; PN-1508



## New Bermudagrass Hybrid

Cattlemen in the Southeast will soon be getting increased beef gains with a newly released bermudagrass hybrid.

Called Coastcross 1, the new hybrid is a cross between a bermudagrass from Kenya and Coastal bermudagrass, the variety now grown extensively throughout the Southeast.

The new hybrid's superior digestibility is the key to increased gains. The forage yield is about the same as Coastal, but it is 11 to 12 percent more digestible. In preliminary hay feeding trials, steers have made up to 30 percent greater gains on Coastcross 1 than on Coastal.

Coastcross 1, developed cooperatively at Tifton, Ga., by ARS and the Georgia Agricultural Experiment Station, is part of a major research program to improve bermudagrass (AGR. RES., Oct. 1966, p. 12).

Because Coastal bermudagrass yields well, present research is aimed at finding highly digestible hybrids that are pest- and cold-resistant. Even the hardiest hybrid is susceptible to winter damage in areas north of Tifton. Researchers are also seeking hybrids that can be propagated by seed rather than by cuttings.

Coastcross 1 is one of 381  $F_1$  hybrids obtained in 1959 when ARS geneticist G. W. Burton crossed Coastal  $\times$  Kenya 14 bermudagrass. Kenya 14 is one of the bermudagrasses from Africa that scientists have been testing in their improvement program.

Coastcross 1 is a completely sterile hybrid that grows taller and has broader leaves than Coastal. It is highly resistant to foliar diseases and to the sting nematode. Like Coastal,

the new hybrid must be established vegetatively.

Coastcross 1 was released to certified growers this spring through the Georgia Crop Improvement Association and should be generally available in 1968.

## Analyzing Cattle Blood Types

Animal and human geneticists are beginning to learn exactly how genes bring about individual characteristics in man and animal.

This work may eventually help scientists do such things as correct abnormalities caused by defective genes or intensify the action of normal genes responsible for good qualities.

C. L. Hatheway, a geneticist at the Cattle Blood Typing Laboratory maintained in Columbus, Ohio, by ARS and the State of Ohio, investigated the genetic action determining the F and V blood types of cattle. This system is similar to the A-B-O system in man, and Hatheway's work ties in closely with similar work being done by human geneticists.

Research was begun on blood type because the genetic control of this trait is relatively simple. In humans, for example, a single series of genes on one pair of chromosomes determines whether blood is typed A, B, AB, or O. Blood type describes the way in which folds of large molecules

on the surfaces of red blood cells react to specific test chemicals.

Hatheway started with FV blood, which means that the red blood cells have both F and V substances. He separated the F from the V substances with a series of chemical treatments and found that the cells of the F type contained twice as much sialic acid as those of the V type.

Sialic acid, a nitrogen-containing derivative of carbohydrate, is used as a building block for constructing complex molecules such as the one responsible for blood type. Apparently, a gene determines whether an individual will have F or V blood type by varying the amount of sialic acid blocks that build a red blood cell molecule.

## Low-Oxygen Potato Storage

Shipping potatoes in low-oxygen atmospheres does not improve potato quality.

ARS plant physiologist W. J. Lipton at Fresno, Calif., tested White Rose potatoes for 8 days in storage atmospheres of  $\frac{1}{2}$ , 1, 5 and 21 percent oxygen at 41, 59, and 68 degrees F.

Growers and shippers had requested the tests because of the availability of controlled atmosphere equipment in the area.

None of the treatments improved



*Potatoes held 8 days in low-oxygen storage. The potato at far left was stored at the normal oxygen level.*

PN-1509

## AGRISEARCH NOTES

potato quality, and in the  $\frac{1}{2}$  and 1 percent oxygen atmospheres at 68 and 59 degrees, potatoes developed serious decay problems, primarily because the tubers had lost their ability to heal over skinned areas. Black heart also developed in many tubers.

At the 5 percent oxygen level, potatoes showed some loss in healing ability but black heart was absent.

### Sweeping Up Soil Samples

A "vacuum cleaner" is part of a device scientists use to collect soil samples for bioassays and chemical analyses.

The device moves soil directly from the ground into a sealed bag and eliminates much of the arduous time-consuming work of conventional sampling methods.

ARS plant physiologist E. L. Robinson and engineers O. B. Wooten and F. E. Fulgham developed the device in cooperation with the Mississippi Agricultural Experiment Station at Stoneville. Improving research procedures is an integral part of ARS research.

The system has six main parts: a vacuum cleaner, a vacuum hose, a self-sealing bag, a variable speed drill-motor, a  $2\frac{1}{2}$  kilowatt alternator, and a soil-sampling tube.

The drill powers a cutter head at the end of the sampling tube. The vacuum hose is connected directly to the top of the sampling tube and carries the soil freed by the cutter into the sealed bag inside the vacuum cleaner. A separate bag is used for each sample. The drill and the vacuum cleaner are powered by the

alternator but another power source could be used.

The sampling tube is the only piece of specially constructed equipment. The other components are available commercially.

Moisture in the soil does not affect the efficiency of the device unless the soil is muddy. The researchers sampled very fine, sandy loam containing 15 percent moisture without difficulty.

Cleaning the device is relatively easy. Tests showed that less than one gram of soil remains in the device after the bagged soil is removed. In some instances, however, this single gram of soil would be intolerable, and modification to allow more thorough cleaning is desirable.

### Screening for Nematode Resistance

Plant resistance to root-knot nematodes can now be determined with precision and speed, promising faster progress in the breeding of new, resistant crop varieties.

In the past, lack of a precise method of screening for resistance has seriously limited breeding work with some crops. The usual screening method has been to expose plants in greenhouses to an inoculum of finely chopped infected roots or soil in which infected plants have been grown. It is not possible, however, to control the number of nematodes applied to a plant or to avoid contaminating the plant with other disease organisms in the soil or roots.

In the new method, the soil is sterilized by steam and the seeds

planted in evenly spaced holes and rows. Specific numbers of larvae are injected into each seed hole. Seeds and nematodes are then covered with sterilized soil and lightly watered. When the plants are dug, root-knot damage can be determined visually.

This method, which allows screening of large plant populations in a limited space, was perfected by research agronomist R. L. Shepherd and nematologist N. A. Minton of ARS, and Alabama crops specialist E. D. Donnelly in tests at Auburn, Ala. The Alabama Agricultural Experiment Station cooperated in the project.

To obtain nematode larvae, the researchers inoculated tomato roots with live larvae and placed the roots for 70 to 90 days in standard wood flats. After the nematodes laid eggs in the roots, the roots were transferred to a mist chamber to incubate the eggs. Researchers collected the freshly hatched larvae for tests.

Inoculating plants with freshly hatched larvae rather than infected roots or soil makes uniform placement of nematodes around plant root systems possible.

**CAUTION:** In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly



careful where there is danger to wildlife or possible contamination of water supplies.



## Date Due




CAT. NO. 23 233

PRINTED IN U.S.A.



BOUND VOLUME

AGRICULTURAL RESEARCH  
AUTHOR

Vols. 13-15, 1964-1967  
TITLE

DATE DUE

BORROWER'S NAME


PRINTED IN U.S.A.



NATIONAL AGRICULTURAL LIBRARY



1022787752